Efficiency, Technological Progress and Regional Comparative Advantage: A Study of Organised Manufacturing Sector in India

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EFFICIENCY, TECHNOLOGICAL PROGRESS AND REGIONAL COMPARATIVE ADVANTAGE

A Study of Organised Manufacturing Sector in India

Technological upgradation and increasing capital intensity in organised manufacturing sector in India has been championed on grounds of improving productivity, efficiency, and competitiveness. In a developing economy this is a costly proposition due to capital scarcity, and the effect of technological changes on productivity and efficiency levels have to be estimated before taking such policies. This paper seeks to estimate trends in Factor Productivity, Technological Progress, and Technological Efficiency in this sector and examines their relative importance also. Technical Efficiency is observed to be moderate and further declining in the nineties. Substantial disparity exists among regions and product groups regarding Efficiency, Technical Progress and Efficiency changes. It is found that increasing capital intensity has been associated with falling productivity, efficiency, and technological deceleration in the nineties. Wider diffusion rather than greater capital use is thus recommended for productivity rise. Regional efficiency matrix is also prepared so that states can focus on specific areas where they have comparative advantages.

Keywords: Productivity; Technical Efficiency; Technological Progress; Organised Manufacturing; Diffusion; Regional Comparative Advantage.
JEL Codes: **D 24; E 23; L 60; O 33; R 11.**

INTRODUCTION

Indian economy has met the challenges of globalisation squarely and has emerged as one of the fastest growing economies in the present times. A major contributor to such sturdy performance has been the high growth of the manufacturing sector. However, the performance can be sustained in the long run only if the sector runs efficiently and is able to ward off global competition. This requires the sector to come out of the protective shell it had been enjoying for better part of the post-independence period in India. The grounds were laid in the late eighties when it was felt that the policies of State control over economy, especially the manufacturing sector, were loosing their effectiveness and in early nineties an effort was made to streamline the economy. The

Structural Adjustment Programme (SAP) initiated in early nineties attempted to do so by doing away with red-tapism and State control, bringing in competition, and ushering in global players in the industrial sector specifically, and in almost all the spheres of our economy, albeit slowly. It was argued that competition would breed efficiency, provide incentives to expand output, and the resultant high GDP growth would naturally use our abundant factor labour more intensively leading to substantial job growth too. In this backdrop, the movements in the manufacturing sector seems quite important as it has been the hotbed of these reforms, witnessing a major shift from the Regulation-Nationalisation-Protection (RNP) regime to Liberalisation-Privatisation-Globalisation (LPG) environment. Due to the central position of the sector, such trends won't remain confined to this sector alone and would create ripples in the economy as a whole. To understand the productivity, efficiency, and comparative advantage of the Indian economy in the long run, it is therefore crucial to understand what has been happening in the manufacturing sector. As efficiency and competitiveness is the buzzword in the new regime, economists have called for technological upgradation of Indian manufacturing sector (Ferrantino, 1992; Mamgain & Awasthi, 2001; Kathuria, 2002; GOI, 2006). However, the focal point of almost all of them is either greater capital use or import of advanced technology, which may turn out to be a costly proposition for a capital-scarce developing economy, both from the standpoint of inadequate resources and its impact on job market. Moreover, desired changes in production process may also be brought about by better mastering of the existing technologies or diffusion. Therefore Total Factor Productivity Growth (TFPG) and Technical Efficiency Changes (TEC) emerge to be important aspects.

Few studies have attempted to estimate productivity trends, efficiency levels, and technological progress in this sector (Joshi and Little, 1998; Agarwal, 2001; Forbes, 2001; Kathuria, 2002; Mitra et al, 2002; Rajan and Sen, 2002; Ray, 2002; Driffield & Kambhampati, 2003; Kambhampati, 2003). However, those dealing with efficiency levels either consider the manufacturing sector in its totality, ignoring the basic fact that different industry groups must be having different production functions and industry level estimates are crucial. Or, they have considered only single time point/duration not attempting to determine trends in efficiency levels, especially after SAP.

In addition, it is imperative that in a large country like India different regions have efficiency in production of different commodities. A schema of comparative advantage can also be built up so that states can concentrate in production/encouragement of those industries in which they have comparatively greater efficiency. This paper therefore addresses the following issues:

1. Determination of total factor productivity growth (TFPG) in the organised manufacturing sector (OMS) in India before and after the SAP, separately for the major industry groups and states;
2. Determining productive efficiency of the sector;
3. Disassociating the effects of pure Technological Progress (TP) from those of Technological Efficiency Change (TEC), Diffusion or Learning-by-Doing;
4. Examining relative importance of TP, TEC and TFPG in the sector;
5. Exploring factors that may have caused inter-industry differences in levels of and changes in efficiency;
6. Exploring factors that may have caused regional disparity in productivity and efficiency levels; and, finally
7. Building up a state level comparative advantage matrix so that states may focus on development of specific industries.

The paper has eight sections. In the next section we discuss the methodological background of the study. The third to fifth sections analyse the results obtained and interprets them. The sixth section explores few factors affecting TE and TP while the seventh section builds up a regional comparative advantage matrix. The final section summarises the main findings and provides few policy suggestions in their light.

I. TECHNOLOGICAL PROGRESS AND TECHNOLOGICAL DIFFUSION METHODOLOGICAL ISSUES

1. Theoretical Background

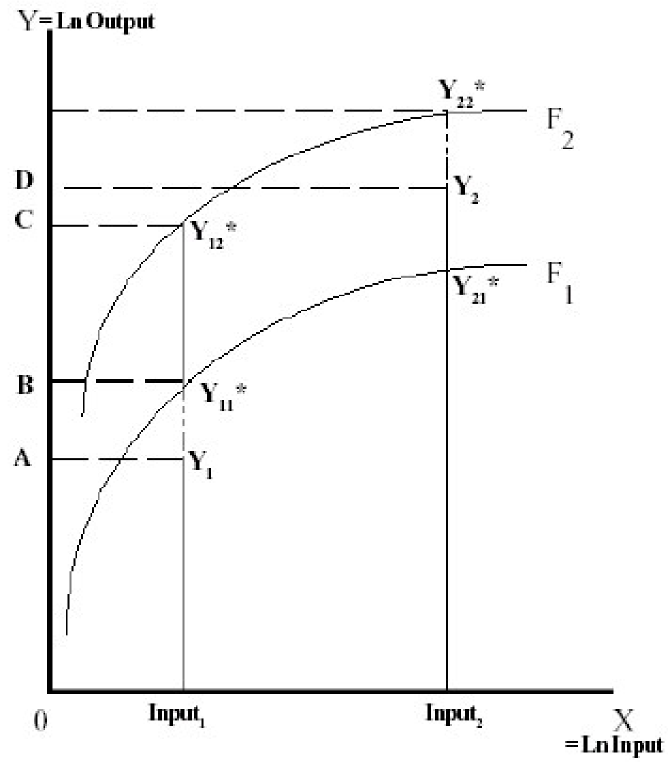
Improvements in labour productivity as a consequence of increase in capital stcok have often been termed cosmetic as 'Capital Deepening' shifts in technique of production necessarily lead to a rise in labour productivity and fall in capital productivity. Therefore, changes in productivity levels are advised to be measured by changes in Total Factor Productivity or Total Factor Productivity Growth (TFPG). Following Growth Accounting Approach as formulated by Solow (Solow, 1957), Output growth is decomposed into two components – growth due to changes in inputs, and that due to other factors.[1] The second component is termed as TFPG and is generally taken as a measure of TP (or, more specifically, contribution of TP towards productivity rise). A positive TFPG implies that the production frontier has expanded outward and there has been a more than proportionate rise in output compared to that in inputs. By decomposing output growth into TFPG and that accounted for by input growth, researchers have compared the relative importance of the two. Also, in cases where TFPG has been substantial and positive, it has been concluded that they are clear instances of TP leading to productivity rise. And naturally, technological upgradation has been suggested as the main policy instrument for productivity improvement.

However, one must remember that TFPG in the growth accounting approach is a residual measure and encompasses the effect of not only TP, but also of better utilisation of capacities, learning by doing, improved labour efficiency, etc. Thus, it is a combination of improved technology and the skill with which known technology is applied by the units, i.e. Technological Efficiency (TE). This second component, i.e. growth in output because of greater experience & skill of workers, better organisation by the entrepreneurs, better utilisation of existing resources, etc. are quite significant in a capital scarce developing economy. Consequently, diffusion of technology is more important than the 'modernity' of the technology itself. One must therefore try to alienate the effects of pure TP from that of Technological Efficiency Changes (TEC) for the units.

In technical terms, TP may be measured by the outward shift of the production frontier. But it is quite realistic to postulate that the 'frontier' would be achieved by only a few, and most of the units would operate within the envelope. Output growth may therefore occur due to three factors – rise in input/resource use (a lateral movement on the 2-dimensional Input-Output Plane), improvement in technology (upward shift of the production frontier), and improvement in technological efficiency (movement from a sub-frontier position towards the frontier). In reality, output growth occurs due to a combination of one or more of these three factors. Following Kalirajan et al (Kalirajan, Obwona and Zhao, 1996), this decomposition of total Output Growth into Input Growth (INPG), Technical Progress (TP), and Technical Efficiency Changes (TEC) can be illustrated by Figure 1. The production frontiers are F_1 and F_2 respectively. For a firm on the frontier, output would be $Y_{11}*$ in period 1 and $Y_{22}*$ in period 2. But, most of the firms will operate within the envelope. Let a representative firm's realized output is Y_1 in period 1 and Y_2 in period 2. The vertical distance between the frontier output and the realized output of the firm, that is, TE1 [= $(Y_{11}^* - Y_1)$] in period 1, and TE2 [=$(Y_{22}^* - Y_2)$] in period 2, respectively, are measures of Technical Inefficiency. Hence, the difference between TE1 and TE2 is the Technical Efficiency Change (TEC) over time. The distance between the two frontiers F_1 and F_2 [that is, $(Y_{22}^* - Y_{21}^*)$ using period 2 input levels, or $(Y_{12}^*-Y_{11}^*)$ using Period 1 input levels] are measures of Technological Progress (TP). The contribution of input growth (INPG) to output growth between periods 1 and 2 would be $(Y_{22}^* - Y_{12}^*)$ using F_2 frontier, or $(Y_{21}^* - Y_{11}^*)$ using F_1 frontier.

Figure 1

Decomposition of Output Growth into TP, TEC and INPG



The output growth from A to D can therefore be decomposed into AB + BC + CD.

Output growth = $Y_2 – Y_1$ = CD + BC + AB

= $(Y_2 – Y_{12}^*) + (Y_{12}^* - Y_{11}^*) + (Y_{11}^* - Y_1)$

= $[(Y_{11}^* - Y_1) – (Y_{22}^* - Y_2)] + (Y_{12}^* - Y_{11}^*) + (Y_{22}^* - Y_{12}^*)$

= [TE1 - TE2] + TP + INPG

= (TEC + TP) + INPG = TFPG + INPG

The present structure breaks up observed output growth to lateral movements on or beneath the production frontier (INPG), movement towards the production frontier (TEC), and shifts in the production frontier itself (TP).

Using Stochastic Frontier Production Function in its Translog form, one can get estimates of Efficiency for each firm in both initial and final periods and thereby calculate TEC.[2] Figures on TFPG can be obtained using Solow's growth accounting approach using a Translog formulation.[3] The contribution of Inputs and TP can thereafter be obtained as INPG = (Output growth – TFPG), and TP = (TFPG – TEC) respectively. One can then study the relative importance of the roles played by each of these three players – Inputs, Technology, and Diffusion, in achieving Output growth.

In the present paper, we follow this methodology to study the roles of these three factors in Organised Manufacturing Sector (OMS) in India. We consider a Translog production function to be operative with Value Added being dependent on Number of Workers, Number of administrative employees, and Fixed Capital (Fixed Assets). The Value terms are at constant 1981-82 prices.

2. Database and Operational Methodology

The period of our study is 1980 to 2000. Annual Survey of Industries database on Organised Manufacturing Sector are brought out by Central Statistical Organisation (CSO). The Economic and Political Weekly Research Foundation (EPWRF) has compiled a comparable series of database from the CSO publications for the period 1970-71 to 1997-98. We have used this database in our study. The data for the period 1998-99 to 2000-01 have been collected from the website of the CSO. To make the new series comparable with the previous one we have used the concordance table between NIC 1987 and NIC 1998 prepared by the CSO, also obtained from CSO website. This requires clubbing some of the industrial activity groups together and we get 14 separate industry groups for our study.[4] Thus, we have a continuous panel data of 14 industry groups and 24 states for the 1980-2000 period, in addition to All India data and that for all industries combined, providing us with 375 observations [(24 states + India) X (14 sectors + All Industry)] for each of the years during 1980-2000. We consider these 375 observations as individual firms (e.g. Leather product industry in West Bengal as one firm, textile industry of Gujarat as another firm, and so on). We also try to analyse regional and sectoral dynamics by combining industries into broad groups like consumer non-durables, semi-durables, intermediate capital goods, and equipment; and regions like North, East, West, South, Central, and North-east.[5]

A significant contribution of this study is that unlike some of the previous studies like Mukherjee and Ray (2004), we estimate the Efficiencies, TFPG and related parameters separately for each of the industries, as it is quite natural that different industries will have different production functions. Moreover, we try to analyse not only efficiency levels but also temporal changes in them, especially after SAP, and some possible factors that can explain regional variation in efficiency levels. In addition, to facilitate decentralised planning, we have also build up a regional comparative advantage matrix to provide us with state-level focus groups. Let us now explore the results in details.

II. FACTOR PRODUCTIVITY

One of the major successes of Indian economy in the post-SAP period has been the substantial growth of the organised manufacturing sector, clocking a 6.5 per cent p.a. growth rate in Value Added between 1990-00, compared to 4 per cent during the earlier decade (Table 1). Historically, a substantial part of growth in Value Added in developing economies is due to rapid increase in input use and little is attributed to improvements in factor productivity. In fact, the average contribution of inputs to output growth in developing nations has been estimated to be close to 70 per cent (Chenery et al, 1986). India's performance, especially that of the organised manufacturing sector, has been much worse as regards TFPG is concerned. During 1959-60 to 1985-86 rate of growth of TFP has been –0.4 per cent per annum (Ahluwalia, 1991). This miserable situation had improved in the later decades and TFPG during 1979-90 has been estimated to be 1.8 per cent p.a. (Unel, 2003). However, the post-SAP period of high growth has also witnessed a substantial drop in factor productivity with a negative TFPG of -1.5 per cent p.a. The growth in output therefore is mainly due to input growth. The drop in factor productivity has been highest in the Non-durable sectors among the industries, and Southern and Eastern states among the regions.

[Table 1 here]

The falling TFP is more evident if we look at the frequencies across industries and states (Table 2). Of the 375 possible observations, 155 observations had positive TFPG during 1980-90 whereas the number declines to 124 during 1990-00. Incidence of positive TFPG has dropped drastically in the Non-durables and Durables but has increased in the Intermediate industries.

[Table 2 here]

Even in the limited number of cases where TFPG have been positive in the post SAP period, it has played the role of second fiddle to input growth (Table 3). Whereas in the earlier decade TFPG was greater than input growth in 74 out of 206 cases of positive Value Added Growth (VAG), in the next decade the number declined to 40 out of 212 cases of positive VAG, that is in less than 25 per cent of cases where actually real Value Added has increased, the role of Factor Productivity has outstripped that of inputs.

[Table 3 here]

III. TECHNICAL EFFICIENCY

We are however more concerned about the efficiency of the OMS in utilising available resources. It is observed that substantial inefficiency exists among this sector with mean efficiency level being 65 per cent in 1980, 71 per cent in 1990 and 70 per cent in 2000 (Table 4 and 5). Consistently high efficiency levels are exhibited by the states of Gujarat, Kerala, Maharashtra and Himachal Pradesh. While Tamil Nadu and West Bengal had satisfactory efficiency levels during the eighties, their position declined alarmingly in the next decade. On the other hand, Karnataka and Delhi have sharply improved their mean efficiency levels in the post-SAP period. Among the industry groups, comparatively higher efficiency levels are exhibited by Textiles, Wood and the Equipment sectors in all the years, Leather products during the eighties, and Paper products during the nineties. In the most recent period, efficiency level has been highest in the southern region, followed by the western region, and in the Machinery & Equipment sector among the product groups.

[Table 4 & 5 here]

IV. DIFFUSION VERSUS TECHNOLOGY UPGRADATION

1. Technical Efficiency Changes

Improvements in technical efficiencies should be a major thrust area in today's globalised scenario where success depends on international competitiveness. In this count however the OMS in India has not done well. We have already noted the fall in efficiency level in the immediate post-SAP period. Though a recovery is evident in the second half of nineties it could not outweigh the initial decline. As a result, average annual rate of Technical Efficiency Change (TEC) has been -0.1 percentage points p.a. during the whole of nineties compared to an increase at 0.6 percentage points p.a. during the eighties (Table 6). However, there are substantial regional and inter-industry disparities regarding TEC. While there has been a consistent drop in technical efficiency in the eastern and northern states, positive TEC even in the post-SAP period are exhibited by the southern states. Among the industries, efficiency levels had increased in the Non-durables and Intermediate sectors during the eighties but declined therein during the nineties. On the other hand in the Durables and Machinery-Equipment sectors TEC was negative during the eighties but turned positive during the nineties. The same picture is exhibited if we look at the frequency of positive TEC between the two periods, which has come down from 179 to173 at the aggregate, but increased in the Southern states and in the Durables, Intermediates, and Machinery-Equipment sectors.

[Table 6 here]

2. Technical Progress

It is generally perceived that technical progress is the main driving force behind productivity growth, especially in manufacturing industries. In fact TFPG have often been considered synonymous with Technical Progress (TP) though that is not so. The performance of OMS regarding TP had been fairly satisfactory during the eighties with an average annual rate of 1 per cent (Table 7). Highest TP was exhibited by the Machinery-Equipment sector followed by the Durables sector. Among the regions, Eastern and Northern states showed quite high rates of TP. In the Western states however, TP was negative. After the SAP, the rate of TP has become negative (-1.4 per cent p.a.) in the aggregate and in all product groups except the Intermediates. Among all observations, while TP was positive in 142 cases during the eighties, it was positive in only 132 cases during the nineties.

[Table 7 here]

It can therefore be commented that in the post-SAP period OMS in India has suffered structural set backs notwithstanding the high VA growth. Factor productivity has been declining, efficiency levels have decreased and TP has decelerated. The output growth is therefore mainly a product of more than proportional increase in inputs. Some possible causes of such dynamics will be discussed in the next section.

3. Diffusion versus Upgradation

If we now compare between the two ingredients of TFPG - TEC and TP - further observations can be made.

[Table 8 here]

The rate of TP has been higher than the rate of TEC both in the positive and negative direction. During the eighties when TP was positive, TEC was also positive but increasing at a lower rate. During the nineties rate of TP is substantially negative while TEC has declined also but at a lower rate. The strength of TEC is therefore lower compared to TP as far as OMS in India is concerned. This is reinforced by the fact that of the 375 observations, TEC is greater than TP in about 50 per cent of the observations during both the periods (Table 8). If we consider only those cases where TFPG is positive we find that TEC is greater than TP in only about one third of the cases during eighties and about one fourth of the cases during the nineties. The balance is therefore substantially tilted towards TP. Thus at the aggregate level diffusion of technology and learning by doing seems to be quite restricted. This is quite alarming as it is expected that even in the face of technological deceleration units will strive that much harder to achieve better organisation and utilisation of available inputs and improve their efficiency levels, more so in a global competitive atmosphere. It is quite evident that this has not happened in India, putting up a big question mark against the sustainability of manufacturing sector output growth. Unless efficiency level improves drastically, the sector is prone to become uncompetitive and therefore its growth is bound to be stifled. We will examine some of the factors behind such dynamics, especially in the post-SAP decade, later.

4. Disaggregated Results

The results regarding TEC and TP that we have outlined so far have variation across industries, and quite expectedly so. It is observed that the Non-durables sector has suffered the most in the post-SAP period with the highest growth rate of inputs and the highest decline in TFPG. This has been accompanied by a drop in efficiency levels and technological deceleration. The Intermediate sector has exhibited the highest growth rates of both VA and inputs. Though TFPG and efficiency levels have declined here, there has occurred positive TP in this sector only in the post-SAP period. The role of TP has also increased in this sector vis-à-vis TEC. In the Durables and Machinery-Equipment sectors, growth rates of VA have increased but TFPG rates have declined. These sectors have also witnessed efficiency gains along with a drop in TP. They are therefore driven more by efficiency changes rather than by pure TP in the recent past.

What explains such inter-industry differences? The answer perhaps lies in the dynamics of the sectors in the post-SAP period. The Non-durables sector has experienced sluggish growth with a declining share in investment, output and VA. Consequently, it has gained neither in terms of efficiency nor in terms of better technology. The Intermediate sector has cornered the majority of investment in the nineties – both in terms of domestic and foreign capital. So it has gained access to sophisticated technology and output growth has taken place along with substantial technological progress. For the Durables and Machinery-Equipment sector on the other hand, the quanta of investment, both domestic and foreign, are lower and thus their access to advanced technology has been limited. Faced with substantial global competition, they had to rely more on better utilisation of available technology and so their growth depended more on efficiency improvements rather than on pure TP. In this regard, presence of larger numbers of small and medium sized firms with lower capital intensity in these two sectors have also played a significant role.

V. FACTORS AFFECTING TECHNICAL PROGRESS AND TECHNICAL EFFICIENCY

1. Capital Intensity

TP has frequently been associated with use of improved technology and increased capital intensity. It should therefore follow that a rise in capital-labour ratio will be accompanied by a positive TP and a rise in factor productivity. The experience of OMS in India is however otherwise. All throughout our study period capital intensity has increased and the trend has accelerated in the post-SAP period. Capital labour ratio has increased at 5.3 per cent p.a. in the post-SAP period compared to 3.2 per cent p.a. in the earlier decade. But TFPG and TP, which were positive in the earlier period, have turned negative after SAP. This perhaps is because of indiscriminate application of highly capital-intensive ‘modern technology’ in the recent times in a bid to raise productivity levels. It seems to have been forgotten that rather than technology alone it is the mastery of technology that matters. As a result, utilisation of available resources, diffusion of existing technology and improved skill formation were given a go by - as evident from the faltering efficiency levels in the post-SAP period. Such an inverse relationship between capital-intensity on one hand and improvements in efficiency and TP on the other is confirmed by the significant negative correlation coefficient between capital-labour ratio and technological efficiency and also between growth in capital-labour ratio on one hand and TEC, TP and Technological Efficiency Growth (TEG) on the other (Table 9). Therefore, the claim that higher capital-intensity (and therefore better technology) is essential for raising productivity & efficiency, and bringing in TP in the manufacturing sector seems to be misplaced. In reality, fixation with modern technology has not only stifled employment and wages in the post SAP period by moving away from our most abundant factor labour; the associated increases in use of capital and its share in output have led to efficiency losses also.

[Table 9 here]

In this light, the present thinking that technological upliftment through greater infusing of capital is a panacea to low productivity (CII, 2006; FICCI, 2005, 2005a; GOI, 2005; Reddy, 2005) should be re-examined and effort should be geared towards better utilisation of available resource rather than increase in input use.

2. Output Growth

While changing factor intensity has affected efficiency levels negatively we must try to identify factors that would improve efficiency levels. It is sometimes argued that 'learning by doing' increases with *'doing'* and efficiency levels improve as output increases. This is observed to be so in the OMS as TEC and TEG are found to be significantly positively associated with growth in value added, both at the aggregate level and when disaggregated by states or industries (Table 9 again).

In addition, regional disparities in efficiency and technological progress depends crucially on factors like regional availability of infrastructural facilities, states' competitiveness and investment climate etc. We explore these issues in the next section.

VI. REGIONAL DIMENSIONS

We have so far discussed levels and trends in productivity, efficiency and TP in OMS in India and have identified certain factors that are affecting such efficiency levels. While these factors affect the manufacturing sector mostly at the macro level, we also find substantial regional variation in levels of productivity, efficiency and TP. In this section we explore some possible reasons behind it.

1. Brief Outline of Regional Trends

We have already noted that the post-SAP drop in factor productivity has been highest in the Southern and Eastern states compared to other parts of the country. Consistently high efficiency levels are exhibited by the states of Gujarat, Kerala, Maharashtra and Himachal Pradesh. While Tamil Nadu and West Bengal had satisfactory efficiency levels during the eighties, their position declined alarmingly in the next decade. On the other hand, Karnataka and Delhi have sharply improved their mean efficiency levels in the post-SAP period. In the most recent period, efficiency level has been highest in the southern region, followed by the western region. While there has been a consistent drop in technical efficiency in the eastern and northern states during both pre- and post-SAP periods, positive TEC even in the post-SAP period are exhibited by the southern states.

2. Factors affecting Regional Productivity and Efficiency Levels

What causes such regional disparity in the levels of productivity, efficiency and TP? It is argued that regional infrastructure play a vital role in determining the productivity and efficiency level of regional industrial sector (Hall & Jones, 1998; Mitra & Ural, 2007). In addition, Investment Climate of the state also determines how much of new investment accompanied by modern technology flows into the state (Veeramani & Goldar, 2004). In other words, the state's competitiveness in terms of infrastructure, governance and human resource seems to be important determinants of productivity, efficiency and TP. Let us now explore the veracity of this hypothesis.

i) Infrastructure

The regional disparities in efficiency levels have sometimes been explained in terms of differences in availability of support facilities, mainly infrastructure. As we have indicated earlier, prospective investors look at the quantity and quality of the support system present in a region before investing. In this selection process, apart from business sentiments, socio-political stability, and ease of operation, which we discuss later, a crucial role is played by the levels of infrastructure available. Today's investors demand smooth transport system, uninterrupted & reliable power supply, availability of healthcare facilities, and proximity to educational institutions. Therefore, it is quite natural that private investment in India is flowing towards infrastructurally advanced regions and rising disparity in availability of the latter in recent years is reflected in increasing inequality of the former. Since new investment, especially foreign capital inflow, play a key role in technological improvement, productivity rise, and efficiency improvement, such differences in investment spread is also likely to lead to differences in productivity, efficiency and technological progress of the manufacturing sector. Therefore, we must take a look at the infrastructural availability situation in the country, especially the regional dimension of it, and whether it really affects the productivity and efficiency levels. To facilitate this, we construct Indices of Infrastructural Availability using Principal Component Analysis for three subsectors of infrastructure - **Physical infrastructure, Financial Infrastructure, and Social Infrastructure.** Further subdivided, Physical Infrastructure consists of Agro-specific Infrastructure, Transport & Communication Infrastructure, and Power Infrastructure. Financial Infrastructure consists mainly of Banking services while Social Infrastructure consists of Educational and Health infrastructure. Each of these components of infrastructure themselves consist of several variables /indicators.[6] Our analysis rests on these measures.

[Table 10 here]

We find that composite indices of Physical, Financial and Social infrastructure have positive association with Efficiency levels (Table 10). Moreover, the association are significantly positive both at the aggregate level and also when disaggregated by industry groups. This indicates that superior infrastructure allows the regional manufacturing sector, and each sub-part of it to have better productivity, higher rise in productivity levels, and greater technical efficiency levels. In addition, the associations have turned significantly stronger in the post-SAP period indicating that infrastructural bottlenecks are crucial factors behind faltering efficiencies of the manufacturing sector in recent past. Further insight reveals that the association is strongest with Social infrastructure (education and health), underlying the importance of skilled and healthy manpower in efficient utilisation of available resources. The results are thus in line with those observed by . Therefore, infrastructural development should form a major area of policy intervention for improving efficiency level in the OMS.

ii) Governance and Business Atmosphere

It is observed generally that private investment tends to stay away from the poorly governed regions and flow mainly to better-managed (and richer) states. This has been true for India also and regional disparity in investment increased after the Structural Adjustment Programme (SAP). Following the SAP, states have been empowered with increased autonomy in key areas like infrastructure, industrial policy, and tax concessions. Slowly but surely the states realised that they can shape their own destiny and while inequalities magnified after SAP, inter-state competition also intensified when states started hot selling themselves as investment destinations.

Several recent studies underlined the key role of the states in shaping the environment in which enterprises from both public and private sectors operate, despite globalization and liberalization. A significant part of the competitive advantage of states is believed to arise from far reaching incentive polices which are designed to attract foreign investment like tax breaks, subsidies etc. States which succeed in attracting greater investment are also successful in having efficient investment. The competition from new entrants and the technological diffusion from modern factories forces the existing OMS units to be more productive and efficient. As a result, well governed states are supposed to have higher productivity and efficiency levels. To test this hypothesis, we make use of the *State Competitiveness Report – 2004* prepared by the National Productivity Council of India. The study identified about 95 socio-economic and technological criteria through extensive research of economic literature and feedback from the business community, government agencies and academia.[7] These were then grouped under five competitiveness factors of Economic Strength, Business Efficiency, Governance Quality, Human Resources, and Infrastructure. Of these, we make use of the Governance and Business Efficiency Scores in this section. The composite Competitiveness Score has also been used. The association of these scores with Productivity and Technical Efficiency levels, both at aggregate and disaggregated (by industry groups) levels indicate that indeed well-governed states have higher productivity and efficiency levels (Table 11). This supports the hypothesis that good governance and business efficiency allows the OMS to achieve higher productivity levels and greater technical efficiency. The role of enabling environment in shaping the regional productivity and efficiency profile is therefore confirmed.

[Table 11 here]

iii) Human Resource and Knowledge Base

Knowledge and Human Resource is perhaps the most crucial of the competitiveness criteria in the present era of *'knowledge economy'*. In the ongoing war for market share regional economies should not rely solely on infrastructure and governance. The ability of a state to develop an excellent education system and improve the knowledge base of the labour force through training is also vital to productivity and efficiency. As states move up the economic scale, they thrive more on the 'brains' or knowledge of the workforce, and higher become their ability to compete with other regions. Therefore, the human resource base of the region is also important. Here we examine whether the human resource base of the states are related to the productivity and efficiency level of the OMS. The HR competitiveness score from the *State Competitiveness Report* has been used to reflect the human resource base. In addition, share of school pass-outs among workers (obtained from NSSO, 2007) have also been used. It is observed that in this case too, productivity and efficiency are positively related to both human resource score and the incidence of school pass-outs among workers. This indicates that the condition of the OMS also depends on the knowledge quotient of the regional population.

It can therefore be concluded that the productivity and efficiency levels of the OMS in India depends crucially on the regional conditions. Those states that are more competitive in terms of better infrastructure, better business environment, good governance, higher human resource base are also the states where the OMS is more productive and more efficient. These regional factors must form the core of industrial policies in the country.

VII. REGIONAL EFFICIENCY MATRIX

We have so far discussed levels and trends in productivity, efficiency and TP in OMS in India and have identified certain factors that are affecting such efficiency levels. While policies must aim at improving the efficiency levels of the sector in general, it would be worthwhile to concentrate in areas of our strength. Encouraging industries exhibiting high efficiency levels may be one major dimension of policy thrust. It is also imperative that in a geographically vast country like India different states will have efficiency in different industries because of natural, traditional and socio-economic factors. Though federal in nature, states in India are quite independent in framing their industrial and economic policies. This provides ample scope for each of the states to focus on industries where they are efficient. These strengths can be judged from two aspects. There would be industries where a certain state is more efficient relative to other states i.e. where it has inter-state comparative advantage. Secondly, there would be industries where a particular state has greater efficiency compared to other industries within that state - indicating intra-state comparative advantage. While from the national macroeconomic standpoint it is optimal that industries are located according to inter-state comparative advantage, for a particular state, the industrial policy should take into account the intra-state inter-industry comparative advantage also. Industries where it enjoys both types of comparative advantage should be the focus group for the state. We have identified the regional comparative advantage matrix where each state-industry combination is denoted by (X_{ij}, Y_{ij}). X_{ij} refers to efficiency rank of i^{th} state in j^{th} industry among all states, and Y_{ij} refers to the rank of j^{th} industry in i^{th} state among all industries in that state. Interstate comparative advantage is supposed to exist if $X_{ij} \leq 10$ and intrastate comparative advantage is supposed to exist if $Y_{ij} \leq 5$. From such a matrix, we have identified the focus groups for each state in Table 13, which is self-explanatory. We hope that this will help in policy formulation at the regional level regarding industrial incentives. At the national level, India's comparative advantage seems to be in production of Textiles, Paper products, Metal products, Machinery-Equipment, and Transport equipment.

[Table 13 here]

VIII. CONCLUSION

We have seen that the tremendous growth of OMS in India in recent past has been mainly fuelled by rising input use and less by productivity gains. Moreover, efficiency improvement seems to have slowed down along with technological deceleration. Consequently, policies for growth of the OMS should give stress on these issues rather than trying to change the basic technology applied therein. Innovation and Adaptation process should be encouraged through knowledge sharing. Training programmes for the workers may be organised to make them better acquainted with the machines they work with. The entrepreneurs must be imparted the basics of optimum organisational skills. In all these aspects, formation of local groups, sharing experiences of successful units, and even sharing of 'idle' resources may prove helpful. In other words, efficiency enhancement should be the prime target for the OMS if it wants to translate its present production boom into sustained growth.

Moreover, any effort to improve the technology involves capital induction and requires substantial amount of financial resources. Given the nature of the economy, this is a costly, and often difficult, proposition. On the other hand, diffusion of existing technology and improvements in organisation, skill, and efficiency require less capital and more 'human involvement', the latter being abundant in our labour surplus economy. The close association of Efficiency and Efficiency changes with educational & health infrastructure as also with the human resource quotient of the region also underlines the importance of investing in human resources as a fruitful way to raise productivity and efficiency. Thus as a policy choice, Efficiency Upgradation appears more viable, effective and lucrative compared to Technological Upgradation alone. In this regard, the role of good governance, business efficiency, and overall competitiveness of the regions has also been observed to be crucial. Therefore, the states must look at ways and means to hard sell themselves by improving the *'enabling environment'* that they provide to the manufacturing sector in particular and the entrepreneurs in general. Moreover, given the limited resource at the disposal of the economy, it would be better to concentrate on regional focus group of industries rather than scatter the energy (and money) across all types of industries. The matrix prepared in this study may be an indicator of areas to look after. Saying all these, it must be acknowledged that Technological Progress also has a role to play and technological upgradation may also be used to raise productivity and improve performance. Among the various product groups, there are few that have benefited more from TP rather than TEC. This diversity must clearly be borne in mind and policies must be framed accordingly. Only when better technology combines with wider diffusion can one expect the OMS to come out of their shell and ensure better returns for the economy, both now and in future.

Notes

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[1] The Growth Accounting Approach (GCA) involves the assumptions of constant returns to scale, competitive markets, and the payment of factors of production according to their marginal products. These assumptions can be questioned, especially in the context of developing countries. However, we have used the translog index of Total Factor Productivity (TFP) here. This is a discrete approximation to the divisia index of technical change. It has the advantage that it does not make rigid assumptions about elasticity of substitution between factors of production (as for instance done by the Solow index), allows for variable elasticity of substitution, and, does not require technological progress to be Hicks-neutral. The GCA can also be criticised in light of the Endogenous Growth Theories (Grossman & Helpman, 1991; Romer, 1992; Barro & Sala-i-Martin, 1995), which emphasise on the importance of knowledge spillovers for growth. However, the EGM has also been empirically questioned by Jones (1995), and theoretical support from the recent models show that policies affect levels and not growth rates of income. We therefore continue with the GCA here.

[2] For theoretical details on Frontier Production Functions, see Aigner et al (1977) and Meeusen and van den Broeck (1977). These original specifications have been altered and extended in a number of ways. For comprehensive reviews of this literature look at Forsund et al (1980), Schmidt (1986), Bauer (1990) and Greene (1993). Battese and Coelli (1992) propose a stochastic frontier production function for (unbalanced) panel data, which has firm-specific 'inefficiency' effects that are assumed to be distributed as truncated normal random variables (as inefficiency can at least be zero when the firm is on the frontier). The 'inefficiency' effects are also permitted to vary over time. This model has been supplemented by their computer programme Frontier Version 4.1 used to empirically measure Efficiency of firms over a number of periods. This programme has been used here.

[3] In this formulation TFPG can be obtained from $\Delta \ln \text{TFP} = \Delta \ln Y_t - \varpi \Delta \ln L_t - (1-\varpi)\Delta \ln K_t$, where $\Delta \ln Y_t = \ln Y_t - \ln Y_{t-1}$, $\Delta \ln L_t = \ln L_t - \ln L_{t-1}$, $\Delta \ln K_t = \ln K_t - \ln K_{t-1}$, ϖ = average of share of labour in output in period t and (t-1).

[4] The Industry groups after clubbing are: Food & Beverages; Textiles; Textile Products; Wood Products; Paper Products; Leather Products; Basic Chemicals; Rubber & Plastic; Non-metallic Minerals; Basic Metals; Metal Products; Electrical, Electronic & Non-electrical Equipment; Transport Equipment; and, Manufacture not elsewhere classified. The Textiles sector according to NIC-1998 includes Cotton Textiles, Natural Fibre products and Wool & Silk Textiles.

[5] The Product Groups are as follows: Non-Durables – Food & Beverages and Textiles; Durables – Textile Products, Wood Products, Paper Products, and Leather Products; Intermediates – Basic Chemicals, Rubber & Plastic, Non-metallic Minerals, Basic Metals, and Metal Products; Machinery-Equipment – Electrical, Electronic & Non-electrical Equipment, and Transport Equipment; and, Manufacture not elsewhere classified. The 16 major states can be regionalised in the following manner. Northern – Punjab, Haryana, Himachal Pradesh and Delhi; Eastern – Bihar, West Bengal, and Orissa; Western – Rajasthan, Gujarat, and Maharashtra; Southern – Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu; and Central – Uttar Pradesh and Madhya Pradesh.

[6] The indices were prepared for an earlier study by Majumder (2005). The constituent indicators of the composite indices are as follows. Agricultural Infrastructure – Irrigation Intensity (Net Irrigated Area as percentage of Net Sown Area), Agricultural Credit per Primary Labourer, Number of Primary

Agrcultural Credit Societies per lakh population. Transport Infrastructure – Road Length per thousand sq. km. area, Surfaced road length as percentage of total road length, Percentage of roads as Highways, Railway Length per thousand sq. km. area, Number of Post Offices per thousand sq. km. area, Number of Letter Boxes per thousand sq. km. area, Postal articles carried per capita. Power Infrastructure – Percentage of villages electrified, Per capita Power generated, Per capita power sold, Plant Load Factor. Educational Infrastructure – Number of Primary & Secondary Schools and Colleges (both per thousand sq. km. area and per thousand population), Teacher-pupil ratio in primary schools, Per capita expenditure on primary education. Health Infrastructure – Hospitals and Dispensaries (both per thousand sq. km. area and per thousand population), Number of Beds in hospitals and dispensaries per lakh population. Researchers have often used the simple PCA method to arrive at composite indices. This method suffers from the drawback that heterogeneity due to varied units implies that changes in units may lead to greater value of indices. To solve this problem, Ghosh and De (2004) have divided the original values of the individual variables by their Standard Deviation. This, however, makes the Variance of all the transformed variables equal to unity, thereby loosing their individual variability. The Modified PCA method (for details see Kundu 1980, 1982) used here standardises the data set by dividing the variables by the respective column-wise means – so that the variables become scale-free, yet retain their individual variances. It is often argued that the mean used should not be the simple average of the indicators, but a weighted average of them, the weights being either area or population of the states, depending on which factor the indicator was standardized by. However here the purpose is to make the variables scale-free and express them relative to a common factor. Hence simple mean will serve our purpose. Also, the second and third sets of composite indices, i.e. Physical, Social, and Composite Infrastructural scores are prepared as simple sum of sectoral indices to give equal representation to the sectoral achievements.

[7] The *State Competitiveness Report* derives states' scores in terms of Economic Strength, Business Efficiency, Governance Quality, Human Resource Base, and Infrastructural Factors. In addition, a Composite score is also derived.

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Table 1

Average Annual Rates of Value Added Growth, Input Growth and TFPG

	VAG		*INPG*		*TFPG*	
	1980-1990	***1990-2000***	***1980-1990***	***1990-2000***	***1980-1990***	***1990-2000***
Region						
Central	5.7	6.3	4.3	6.6	1.4	-0.4
East	1.2	1.3	-1.4	2.3	2.6	-1.0
North	5.9	7.3	3.5	8.9	2.4	-1.7
North East	10.9	-1.8	4.8	7.9	6.1	-9.7
South	4.9	7.3	3.3	9.3	1.6	-2.0
West	3.3	7.8	3.2	9.7	0.1	-1.9
All India	**4.0**	**6.5**	**2.4**	**8.0**	**1.6**	**-1.5**
Product Group						
Non-Durables	3.2	4.2	1.6	7.1	1.6	-2.8
Durables	0.8	5.5	0.7	6.1	0.1	-0.5
Intermediates	4.6	8.4	3.2	9.1	1.4	-0.7
Machinery & Equip	3.7	5.4	2.2	6.9	1.5	-1.5
Others	12.1	8.6	12.1	11.5	0.0	-2.8
All Industries	**4.0**	**6.5**	**2.4**	**8.0**	**1.6**	**-1.5**

Source: Authors' Calculation based on CSO (Various Years) and EPWRF (2002).

Table 2

Incidence of Positive Value Added Growth, Input Growth and TFPG

	VAG		*INPG*		*TFPG*	
	1980-1990	***1990-2000***	***1980-1990***	***1990-2000***	***1980-1990***	***1990-2000***
Region						
Central	27	25	27	25	19	11
East	26	25	28	22	21	21
North	49	46	52	52	37	26
North East	17	16	13	13	17	14
South	56	62	54	62	38	38
West	31	38	31	42	23	14
All India	**13**	**14**	**14**	**14**	**11**	**4**
Product Group						
Non-Durables	43	47	35	48	49	25
Durables	39	29	42	33	26	17
Intermediates	78	83	79	87	47	57
Machinery & Equip	30	34	32	29	23	18
Others	16	19	17	19	10	7
All Industries	**20**	**19**	**18**	**17**	**19**	**15**
All Total	**206**	**212**	**205**	**216**	**155**	**124**

Source: Same as Table 1.

Table 3

Relative Strengths of TFPG & INPG in Value Added Growth

	TFPG > INPG			
	1980-90		*1990-2000*	
	All Cases	*Positive VAG*	*All Cases*	*Positive VAG*
Region				
Central	10	10 (27)	7	4 (25)
East	20	9 (26)	21	10 (25)
North	24	17 (49)	18	8 (46)
North East	16	10 (17)	20	8 (16)
South	21	16 (56)	16	14 (62)
West	15	12 (31)	4	3 (38)
All India	**5**	4 (13)	**0**	0 (14)
Product Group				
Non-Durables	36	23 (43)	15	9 (47)
Durables	21	16 (39)	18	7 (34)
Intermediates	31	26 (78)	24	13 (83)
Machinery & Equip	14	7 (30)	13	9 (34)
Others	3	2 (16)	5	2 (19)
All Industries	**11**	**9 (20)**	**11**	**7 (19)**
All Total	**106**	**74 (206)**	**75**	**40 (212)**

Source: Same as Table 1.

Table 4
Technical Efficiencies of Organised Manufacturing Sector in India – 1980-2000
All Industry by States

States	***Technical Efficiency***					***Annual Rates of Change***	
	1980	***1984***	***1990***	***1994***	***2000***	***1980-1990***	***1990-2000***
Andaman	0.0	25.5	83.9	73.5	90.6	8.4	0.7
Andhra Pr	69.0	70.5	53.9	82.7	77.6	-1.5	2.4
Assam	62.1	97.0	92.6	94.4	67.9	3.1	-2.5
Bihar	52.2	69.9	91.6	89.4	75.9	3.9	-1.6
Delhi	66.6	64.0	85.8	95.0	81.7	1.9	-0.4
Gujarat	100.0	91.2	82.0	88.0	97.4	-1.8	1.5
Haryana	99.5	57.9	76.2	71.5	94.5	-2.3	1.8
Himachal Pr	92.6	78.6	69.3	75.9	96.2	-2.3	2.7
J & K	43.8	39.4	83.9	89.2	90.6	4.0	0.7
Karnataka	71.7	76.9	83.9	88.3	67.0	1.2	-1.7
Kerala	97.2	90.1	89.0	87.7	100.0	-0.8	1.1
Madhya Pr	65.6	52.3	79.2	70.1	88.3	1.4	0.9
Maharashtra	92.3	92.8	94.2	84.5	91.9	0.2	-0.2
Manipur	0.0	59.3	83.9	59.4	90.6	8.4	0.7
Meghalaya	0.0	24.9	83.9	85.5	90.6	8.4	0.7
Nagaland	0.0	91.9	83.9	73.6	90.6	8.4	0.7
Orissa	71.9	36.4	86.3	77.3	64.5	1.4	-2.2
Pondichery	0.0	44.1	83.0	92.7	90.6	8.3	0.8
Punjab	67.5	52.8	83.0	58.2	86.8	1.6	0.4
Rajasthan	83.5	59.5	69.4	85.8	88.6	-1.4	1.9
Tamilnadu	90.3	85.2	83.5	79.8	89.2	-0.7	0.6
Tripura	0.0	51.7	81.1	57.2	90.6	8.1	1.0
Uttar Pr	52.5	52.1	81.1	87.5	76.4	2.9	-0.5
W Bengal	82.5	64.8	56.8	54.9	63.9	-2.6	0.7
Region							
Central	58.2	54.8	61.0	56.8	61.3	0.3	0.3
East	63.8	60.3	59.7	58.5	58.5	-0.4	-0.1
North	67.6	54.8	62.1	61.5	61.6	-0.6	-0.1
North East	68.5	66.7	70.3	66.3	60.6	0.2	-0.5
South	64.9	58.2	62.3	57.8	63.7	-0.3	0.1
West	65.1	64.7	67.8	64.5	61.9	0.3	-0.6
All India	**64.4**	**65.5**	**70.8**	**61.5**	**70.1**	**0.6**	**-0.1**

Source: Same as Table 1.

Table 5

Technical Efficiencies of Organised Manufacturing Sector in India – 1980-2000

All States by Industries

Industry Groups	***Technical Efficiency***					***Annual Rate of Change***	
	1980	***1984***	***1990***	***1994***	***2000***	***1980-1990***	***1990-2000***
Food & Beverages	52.4	75.0	42.9	71.7	56.7	-1.0	1.4
Textiles	76.1	75.8	79.8	83.8	94.6	0.4	1.5
Textile Products	50.5	23.0	100.0	40.0	46.1	5.0	-5.4
Wood Products	86.1	77.3	100.0	86.8	73.5	1.4	-2.7
Paper Products	62.7	41.5	73.5	43.2	78.1	1.1	0.5
Leather Products	100.0	60.1	20.5	60.5	61.0	-8.0	4.1
Basic Chemicals	39.6	71.7	52.4	34.2	53.5	1.3	0.1
Rubber & Plastic	15.4	21.1	53.5	55.3	30.5	3.8	-2.3
Non-metallic Min	76.1	46.8	66.8	17.7	42.3	-0.9	-2.5
Basic Metals	53.6	70.0	57.1	60.9	60.0	0.4	0.3
Metal Products	78.3	51.1	78.8	75.7	79.8	0.1	0.1
Elec & Non-elec Equip	77.6	63.7	82.3	64.4	73.4	0.5	-0.9
Transport Equipment	72.6	69.6	34.2	68.0	86.6	-3.8	5.2
Others	40.2	82.3	81.8	70.9	60.0	4.2	-2.2
Product Group							
Non-Durables	59.7	57.9	74.2	65.2	65.8	1.5	-0.8
Durables	82.9	59.6	64.7	63.5	70.9	-1.8	0.6
Intermediates	52.6	52.1	61.7	48.8	53.2	0.9	-0.9
Machinery & Equip	75.1	66.7	58.3	66.2	80.0	-1.7	2.2
Others	57.8	78.4	82.9	62.8	75.3	4.2	-2.2
All Industries	**64.4**	**65.5**	**70.8**	**61.5**	**70.1**	**0.6**	**-0.1**

Source: Same as Table 1.

Table 6

Average Annual Rates of TEC and Incidence of Positive TEC

	Average Annual Rates of TEC		***Incidence of Positive TEC***	
	1980-1990	***1990-2000***	***1980-1990***	***1990-2000***
Region				
Central	0.3	0.3	17	19
East	-0.4	-0.1	28	29
North	-0.6	-0.1	34	32
North East	0.2	-0.5	43	36
South	-0.3	0.1	35	37
West	0.3	-0.6	22	20
All India	**0.6**	**-0.1**	**9**	**7**
Product Group				
Non-Durables	1.5	-0.8	45	28
Durables	-1.8	0.6	39	43
Intermediates	0.9	-0.9	56	60
Machinery & Equip	-1.7	2.2	23	30
Others	4.2	-2.2	16	12
All Industries	**0.6**	**-0.1**	**17**	**18**
All Total			**179**	**173**

Source: Same as Table 1.

Table 7

Average Annual Rates of TP and Incidence of Positive TP

	Average Annual Rates of TP		***Incidence of Positive TP***	
	1980-1990	***1990-2000***	***1980-1990***	***1990-2000***
Region				
Central	1.1	-0.7	18	8
East	3.0	-0.9	16	23
North	3.0	-1.6	36	28
North East	5.9	-9.2	10	18
South	1.8	-2.1	40	40
West	-0.2	-1.3	22	15
All India	**1.0**	**-1.4**	**7**	**5**
Product Group				
Non-Durables	0.1	-2.0	37	29
Durables	2.0	-1.1	30	14
Intermediates	0.5	0.2	38	56
Machinery & Equip	3.1	-3.6	27	23
Others	-4.2	-0.7	11	10
All Industries	**1.0**	**-1.4**	**16**	**17**
All Total			**142**	**132**

Source: Same as Table 1.

Table 8

Relative Strengths of TEC & TP in TFPG

	TEC > TP			
	1980-90		*1990-2000*	
	All Cases	*Positive TFPG*	*All Cases*	*Positive TFPG*
Region				
Central	14	7 (19)	19	5 (11)
East	35	12 (21)	32	6 (21)
North	29	9 (37)	43	7 (26)
North East	39	10 (17)	37	14 (14)
South	31	12 (38)	29	7 (38)
West	20	6 (23)	23	4 (14)
All India	**11**	**8 (11)**	**9**	**2 (4)**
Product Group				
Non-Durables	37	15 (47)	35	4 (22)
Durables	36	9 (24)	47	7 (14)
Intermediates	66	19 (45)	59	10 (54)
Machinery & Equip	18	9 (21)	27	4 (16)
Others	12	5 (10)	14	2 (7)
All Industries	**10**	**7 (19)**	**10**	**4 (15)**
All Total	**169**	**57 (147)**	**182**	**27 (113)**

Source: Same as Table 1.

Table 9

Interlinkages of Technical Efficiency Changes and Technical Progress

Period	***Variables***	***TEC***	***TP***	***TEG***
1980-1984	**Growth in Capital Labour Ratio**	-0.08	-0.18**	-0.09
	Growth in Value Added	0.37**		0.25**
1984-1990	**Growth in Capital Labour Ratio**	-0.15**	-0.08	-0.18**
	Growth in Value Added	0.26**		0.26**
1990-1994	**Growth in Capital Labour Ratio**	-0.13**	-0.02	-0.13*
	Growth in Value Added	0.31**		0.21**
1994-2000	**Growth in Capital Labour Ratio**	-0.10*	0.14*	-0.16**
	Growth in Value Added	0.37**		0.28**

Source: Same as Table 1.

Note: ** and * indicates significance at 5 per cent and 10 per cent levels respectively. Coefficients with significance level above 20 per cent are not reported

Table 10
Infrastructure and Technical Efficiency - Correlation Coefficients

Interlinked Variables	*1980*	*1984*	*1990*	*1994*	*2000*
Capital Labour Ratio	-0.22**	-0.14**	-0.19**	-0.13*	-0.08
Physical Infrastructure	0.11*	0.03	0.10*	0.14**	0.12**
Financial Infrastructure	0.06		0.05	0.13**	0.14**
Social Infrastructure	0.07	0.02	0.10	0.16**	0.14**
Composite Infrastructure	0.07		0.08	0.14**	0.13**

Source: Author's Calculations.
Note: ** and * indicates significance at 5 per cent and 10 per cent levels respectively. Coefficients with significance level above 20 per cent are not reported

Table 11
Enabling Environment and Productivity & Efficiency Levels - Correlation Coefficients

Variables	*Product Group*	*Association With*	
		Business Efficiency	*Governance Quality*
Total Factor Productivity	**Non-Durables**	0.85**	0.28*
	Durables	0.52**	0.78**
	Intermediates	0.10	0.58**
	Machinery & Equip	0.31*	0.58**
	Others	0.84**	0.45**
	All Industries	0.86**	0.98**
Technical Efficiency	**Non-Durables**	0.26*	0.11
	Durables		
	Intermediates	0.12	0.10
	Machinery & Equip	0.17*	0.19*
	Others	0.31**	0.31**
	All Industries	0.16*	0.10

Source: Same as Table 9.
Note: ** and * indicates significance at 5 per cent and 10 per cent levels respectively. Coefficients with significance level above 20 per cent are not reported

Table 12
Human Resource and Productivity & Efficiency Levels - Correlation Coefficients

Variables	*Product Group*	*Association With*	
		Human Resource Base	*School-Pass among Workers*
Total Factor Productivity	**Non-Durables**		0.07
	Durables	0.10	0.11*
	Intermediates	0.19*	0.09
	Machinery & Equip	0.25*	0.41**
	Others	0.37**	0.16*
	All Industries	0.12	0.23*
Technical Efficiency	**Non-Durables**	0.12	0.18*
	Durables		
	Intermediates	0.10	0.06
	Machinery & Equip	0.10	0.36**
	Others		0.14
	All Industries	0.37**	0.34**

Source: Same as Table 9.
Note: ** and * indicates significance at 5 per cent and 10 per cent levels respectively. Coefficients with significance level above 20 per cent are not reported

Table - 13

Identification of Focus Groups for States

State	*Inter-state Efficiency*	*Intra-state Efficiency*	*Focus Group*
Andhra Pr	Paper Products; Metal Products; Machinery-Equip;	Paper Products; Leather Products; Metal Products; Machinery-Equip	Paper Products; Metal Products; Machinery-Equip
Assam	Textile Products; Paper Products; Leather Products; Rubber & Plastic; Non-metallic Minerals	Paper Products; Leather Products; Rubber & Plastic; Non-metallic Minerals	Paper Products; Leather Products; Rubber & Plastic; Non-metallic Minerals
Bihar	Food & Beverages; Textile Products; Paper Products; Leather Products; Basic Metals	Food & Beverages; Paper Products; Leather Products; Basic Metals	Food & Beverages; Paper Products; Leather Products; Basic Metals
Delhi	Food & Beverages; Textiles; Textile Products; Wood Products; Paper Products; Leather Products; Basic Chemicals; Metal Product; Machinery-Equip; Transport Equip;	Textiles; Wood Products; Basic Chemicals; Transport Equip	Textiles; Wood Products; Basic Chemicals; Transport Equip
Gujarat	Textile Products; Wood Products; Rubber & Plastic; Basic Metals	Textile Products; Wood Products; Paper Products; Basic Metals	Textile Products; Wood Products; Basic Metals
Haryana	Food & Beverages; Wood Products; Non-metallic Minerals; Basic Metals	Food & Beverages; Paper Products; Non-metallic Minerals; Basic Metals	Food & Beverages; Non-metallic Minerals; Basic Metals
Himachal Pr	Food & Beverages; Textile Products; Leather Products; Basic Chemicals; Non-metallic Minerals; Machinery-Equip	Leather Products; Basic Chemicals; Non-metallic Minerals; Machinery-Equip	Leather Products; Basic Chemicals; Non-metallic Minerals; Machinery-Equip
J & K	Textile Products; Basic Chemicals; Rubber & Plastic; Machinery-Equip; Transport Equip	Basic Chemicals; Rubber & Plastic; Machinery-Equip; Transport Equip	Basic Chemicals; Rubber & Plastic; Machinery-Equip; Transport Equip
Karnataka	Food & Beverages; Textiles; Wood Products; Paper Products; Basic Chemicals; Non-metallic Minerals; Metal Products	Textiles; Wood Products; Paper Products; Metal Products; Machinery-Equip	Textiles; Wood Products; Paper Products; Metal Products
Kerala	Paper Products; Leather Products; Rubber & Plastic; Non-metallic Minerals; Basic Metals; Transport Equip	Paper Products; Leather Products; Rubber & Plastic; Basic Metals; Transport Equip	Paper Products; Leather Products; Basic Metals; Transport Equip
Madhya Pr	Textiles; Paper Products; Leather Products; Non-metallic Minerals; Basic Metals	Textiles; Paper Products; Leather Products; Basic Metals	Textiles; Paper Products; Leather Products; Basic Metals
Maharashtra	Textiles; Wood Products; Basic Chemicals; Rubber & Plastic; Non-metallic Minerals; Machinery-Equip	Textiles; Basic Chemicals; Rubber & Plastic; Machinery-Equip	Textiles; Basic Chemicals; Rubber & Plastic; Machinery-Equip
Orissa	Textile Products; Leather Products; Basic Metals	Textile Products; Wood Products; Paper Products; Leather Products; Basic Metals	Textile Products; Leather Products; Basic Metals

Table - 13

Identification of Focus Groups for States (contd)

State	***Inter-state Efficiency***	***Intra-state Efficiency***	***Focus Group***
Punjab	Food & Beverages; Textiles; Basic Chemicals; Rubber & Plastic	Basic Chemicals; Rubber & Plastic; Metal Products; Machinery-Equip	Basic Chemicals; Rubber & Plastic
Rajasthan	Textile Products; Leather Products; Basic Metals; Metal Products	Textile Products; Paper Products; Leather Products; Basic Metals; Metal Products	Textile Products; Leather Products; Basic Metals; Metal Products
Tamilnadu	Textiles; Paper Products; Non-metallic Minerals; Metal Products; Transport Equip	Textiles; Paper Products; Non-metallic Minerals; Metal Products; Transport Equip	Textiles; Paper Products; Non-metallic Minerals; Metal Products; Transport Equip
Uttar Pr	Food & Beverages; Textile Products; Wood Products; Basic Metals; Machinery-Equip	Wood Products; Paper Products; Basic Metals; Metal Products; Machinery-Equip	Wood Products; Basic Metals; Machinery-Equip
W Bengal	Food & Beverages; Textiles; Textile Products; Wood Products; Metal Products; Transport Equip	Textiles; Textile Products; Paper Products; Metal Products; Transport Equip	Textiles; Textile Products; Metal Products; Transport Equip